CLAIMS

1. A method comprising:

separating, at a device, an input audio signal into at least a low-band signal and a high-band signal, the low-band signal corresponding to a low-band frequency range and the high-band signal corresponding to a high-band frequency range;

determining a characteristic of the low-band signal;

selecting a non-linear processing function of a plurality of non-linear processing functions based on the characteristic;

generating a first extended signal based on the low-band signal and the non-linear processing function; and

generating at least one adjustment parameter based on the first extended signal, the high-band signal, or both.

2. The method of claim 1, wherein the non-linear processing function is selected after the input audio signal is received at the device, wherein the first extended signal is generated by mixing a noise signal and a second extended signal, and wherein the at least one adjustment parameter is determined based on the first extended signal and based on the high-band signal.

3. The method of claim 2, wherein a first proportion of the noise signal and a second proportion of the second extended signal are mixed, and wherein the first proportion and the second proportion are determined based on a harmonicity of at least one of the low-band signal, the high-band signal, or the input audio signal.

4. The method of claim 3, further comprising determining the harmonicity based on an estimate of periodicity of the input audio signal in an audio frame, wherein the non-linear processing function is selected in response to receiving the input audio signal.

5. The method of claim 2, further comprising generating the second extended signal by filtering a third extended signal, wherein a bandwidth of the second extended signal corresponds to the high-band frequency range.

6. The method of claim 5, further comprising generating the third extended signal by applying the non-linear processing function to the low-band signal, wherein the non-linear processing function is selected on a frame by frame basis.

7. The method of claim 2, wherein the second extended signal is generated by:

applying a linear transformation to a third extended signal, and

selecting transform coefficients corresponding to the high-band frequency range.

8. The method of claim 7, wherein the non-linear processing function is selected by a function selector based on the characteristic of the low-band signal or based on a determined value of the characteristic of the low-band signal, and wherein the linear transformation corresponds to a discrete cosine transform.

9. The method of claim 1, further comprising selecting a first non-linear processing function of the plurality of non-linear processing functions in response to determining that the at least one adjustment parameter satisfies a first condition.

10. The method of claim 1, wherein the non-linear processing function is selected from among:

a first non-linear processing function of the plurality of non-linear processing functions that corresponds to a low order power function, and

a second non-linear processing function of the plurality of non-linear processing functions that corresponds to a high order power function.

11. The method of claim 1, further comprising:

separating the input audio signal into at least the low-band signal and the high-band signal using analysis filter banks; and

determining a parameter associated with a frame of the input audio signal,

wherein the characteristic is an audio characteristic of the low-band signal, wherein the at least one adjustment parameter corresponds to at least one gain adjustment parameter associated with the high-band signal, and wherein the parameter associated with the frame comprises one of a coding mode chosen to encode the low-band signal, a periodicity of the frame, an amount of non-periodic noise in the frame, or a spectral tilt corresponding to the frame.

12. A method comprising:

receiving, at a device, low-band data corresponding to at least a low-band signal of an input audio signal;

decoding the low-band data to generate a synthesized low-band audio signal;

determining a characteristic of the low-band signal;

selecting a non-linear processing function of a plurality of non-linear processing functions based on the characteristic; and

generating a synthesized high-band audio signal based on the synthesized low-band audio signal and the non-linear processing function.

13. The method of claim 12, further comprising generating an output audio signal by combining the synthesized low-band audio signal and the synthesized high-band audio signal, wherein the non-linear processing function is selected based on the synthesized low-band audio signal, and wherein a first bandwidth of the output audio signal is greater than a second bandwidth of the synthesized low-band audio signal.

14. The method of claim 12, further comprising generating a first extended signal by mixing a noise signal and a second extended signal, wherein the synthesized high-band audio signal is generated based on the first extended signal and based on at least one adjustment parameter, wherein a first proportion of the second extended signal and a second proportion of the noise signal are mixed, and wherein the first proportion and the second proportion are determined based on at least one of a received harmonicity parameter or the low-band data.

15. The method of claim 12, wherein the synthesized high-band audio signal is generated by scaling a first extended signal by a factor that is associated with at least one adjustment parameter.

16. The method of claim 12, further comprising generating a first extended signal based on a second extended signal and based on a third extended signal, wherein the second extended signal corresponds to a high-band frequency range.

17. The method of claim 12, further comprising generating a first extended signal based on a second extended signal, wherein the second extended signal is generated by:

applying a linear transformation to a third extended signal, the linear transformation corresponding to a discrete cosine transform, and the third extended signal based on the synthesized low-band audio signal and based on the non-linear processing function; and

selecting transform coefficients corresponding to a high-band frequency range.

18. The method of claim 12, further comprising selecting the non-linear processing function:

based on a parameter received at the device; and

on a frame by frame basis.

19. The method of claim 12, wherein the receiving, the decoding, the determining, the selecting, and the generating are performed within the device, and wherein the device comprises a mobile communication device.

20. The method of claim 12, wherein the receiving, the decoding, the determining, the selecting, and the generating are performed within a fixed location data unit.

21. An apparatus comprising:
a memory; and
a processor configured to:
separate an input audio signal into at least a low-band signal and a high-band signal, the low-band signal corresponding to a low-band frequency range and the high-band signal corresponding to a high-band frequency range;
determine a characteristic of the low-band signal;
select a non-linear processing function of a plurality of non-linear processing functions based on the characteristic;
generate a first extended signal based on the low-band signal and the non-linear processing function; and
generate at least one adjustment parameter based on the first extended signal, the high-band signal, or both.

22. The apparatus of claim 21, wherein the processor is configured to select the non-linear processing function after the input audio signal is separated into at least the low-band signal and the high-band signal, to generate the first extended signal by mixing a noise signal and a second extended signal, and to determine the at least one adjustment parameter based on the first extended signal and based on the high-band signal.

23. The apparatus of claim 22, wherein a first proportion of the noise signal and a second proportion of the second extended signal are mixed, and wherein the processor is configured to determine the first proportion and the second proportion based on a harmonicity of at least one of the low-band signal, the high-band signal, or the input audio signal.

24. The apparatus of claim 23, wherein the processor is further configured to determine the harmonicity based on an estimate of periodicity of the input audio signal in an audio frame.

25. The apparatus of claim 22, wherein the processor is further configured to generate the second extended signal by filtering a third extended signal, and wherein a bandwidth of the second extended signal corresponds to the high-band frequency range.

26. The apparatus of claim 25, wherein the processor is further configured to generate the third extended signal by applying the non-linear processing function to the low-band signal.

27. The apparatus of claim 22, wherein the processor is configured to separate the input audio signal into at least the low-band signal and the high-band signal using analysis filter banks and to generate the second extended signal by:

applying a linear transformation to a third extended signal, the linear transformation corresponding to a discrete cosine transform, and

selecting transform coefficients corresponding to the high-band frequency range.

28. The apparatus of claim 21, wherein the processor is further configured to determine a parameter associated with a frame of the input audio signal, wherein the non-linear processing function is selected based on the parameter, wherein a first non-linear processing function of the plurality of non-linear processing functions is selected in response to determining that the parameter satisfies a first condition, and wherein a second non-linear processing function of the plurality of non-linear processing functions is selected in response to determining that the parameter satisfies a second condition.

29. The apparatus of claim 28, wherein the parameter associated with the frame is one of a coding mode chosen to encode the low-band signal, a periodicity of the frame, an amount of non-periodic noise in the frame, or a spectral tilt corresponding to the frame.

30. The apparatus of claim 21, wherein the plurality of non-linear processing functions includes a low order power function and a high order power function, and wherein the at least one adjustment parameter corresponds to at least one gain adjustment parameter associated with the high-band signal.

31. The apparatus of claim 21, wherein the processor is integrated into an encoder system.

32. The apparatus of claim 21, further comprising:

an antenna; and

a receiver coupled to the antenna and configured to receive a signal corresponding to the input audio signal.

33. The apparatus of claim 32, wherein the processor, the memory, the receiver, and the antenna are integrated into a mobile communication device.

34. The apparatus of claim 32, wherein the processor, the memory, the receiver, and the antenna are integrated into a fixed location data unit.

35. An apparatus comprising:
a memory; and
a processor configured to:
receive low-band data corresponding to at least a low-band signal of an input audio signal;
decode the low-band data to generate a synthesized low-band audio signal;
determine a characteristic of the low-band signal;
select a non-linear processing function of a plurality of non-linear processing functions based on the characteristic; and
generate a synthesized high-band audio signal based on the synthesized low-band audio signal and the non-linear processing function.

36. The apparatus of claim 35, wherein the processor is further configured to generate an output audio signal by combining the synthesized low-band audio signal and the synthesized high-band audio signal, and wherein a first bandwidth of the output audio signal is greater than a second bandwidth of the synthesized low-band audio signal.

37. The apparatus of claim 35, wherein the processor is further configured to generate a first extended signal by mixing a noise signal and a second extended signal and to generate the synthesized high-band audio signal based on the first extended signal and based on at least one adjustment parameter.

38. The apparatus of claim 37, wherein a first proportion of the second extended signal and a second proportion of the noise signal are mixed, and wherein the first proportion and the second proportion are determined based on at least one of a received harmonicity parameter or the low-band data.

39. The apparatus of claim 37, wherein the processor is configured to generate the synthesized high-band audio signal by scaling the first extended signal by a factor associated with the at least one adjustment parameter.

40. The apparatus of claim 37, wherein the processor is further configured to generate the second extended signal by filtering a third extended signal, and wherein the second extended signal corresponds to a high-band frequency range.

41. The apparatus of claim 37, wherein the second extended signal is generated by:
applying a linear transformation to a third extended signal, and
selecting transform coefficients corresponding to a high-band frequency range.

42. The apparatus of claim 41, wherein the linear transformation corresponds to a discrete cosine transform.

43. The apparatus of claim 41, wherein the processor is further configured to generate the third extended signal based on the synthesized low-band audio signal and based on the non-linear processing function.

44. The apparatus of claim 35, wherein the processor is further configured to select the non-linear processing function based on a received parameter or based on the low-band data.

45. The apparatus of claim 35, wherein the processor is integrated into a mobile device that includes a decoder system.

46. An apparatus comprising:
means for separating an input audio signal into at least a low-band signal and a high-band signal, the low-band signal corresponding to a low-band frequency range and the high-band signal corresponding to a high-band frequency range;
means for determining a characteristic of the low-band signal;
means for selecting a non-linear processing function of a plurality of non-linear processing functions based on the characteristic;
first means for generating a first extended signal based on the low-band signal and the non-linear processing function; and
second means for generating at least one adjustment parameter based on the first extended signal, the high-band signal, or both.

47. The apparatus of claim 46, further comprising means for mixing a noise signal and a second extended signal, wherein:
the means for selecting is configured to select the non-linear processing function after the input audio signal is received at the means for separating,

the means for mixing is configured to generate the first extended signal, and

the second means for generating is configured to determine the at least one adjustment parameter based on the first extended signal and based on the high-band signal.

48. The apparatus of claim 47, wherein a first proportion of the noise signal and a second proportion of the second extended signal are mixed, and wherein the first proportion and the second proportion are determined based on a harmonicity of at least one of the low-band signal, the high-band signal, or the input audio signal.

49. The apparatus of claim 46, wherein the means for determining, the means for selecting, the first means for generating, and the second means for generating are integrated into a mobile device.

50. An apparatus comprising:

means for receiving low-band data corresponding to at least a low-band signal of an input audio signal;

means for decoding the low-band data to generate a synthesized low-band audio signal;

means for determining a characteristic of the low-band signal;

means for selecting a non-linear processing function of a plurality of non-linear processing functions based on the characteristic; and

means for generating a synthesized high-band audio signal based on the synthesized low-band audio signal and the non-linear processing function.

51. The apparatus of claim 50, wherein the low-band data indicates characteristics of the low-band signal.

52. The apparatus of claim 50, wherein the means for generating is configured to generate the synthesized high-band audio signal by scaling a first extended signal by a factor that is associated with at least one adjustment parameter.

53. The apparatus of claim 50, wherein the means for determining, the means for selecting, and the means for generating are integrated into a communication mobile device.

54. The apparatus of claim 50, wherein the means for determining, the means for selecting, and the means for generating are integrated into a fixed location data unit.

55. A computer-readable storage device storing instructions that, when executed by a processor, cause the processor to perform operations comprising:

separating an input audio signal into at least a low-band signal and a high-band signal, the low-band signal corresponding to a low-band frequency range and the high-band signal corresponding to a high-band frequency range;

determining a characteristic of the low-band signal;

selecting a non-linear processing function of a plurality of non-linear processing functions based on the characteristic;

generating a first extended signal based on the low-band signal and the non-linear processing function; and

generating at least one adjustment parameter based on the first extended signal, the high-band signal, or both.

56. The computer-readable storage device of claim 55, wherein execution of the instructions causes the processor to select the non-linear processing function after the input audio signal is separated into at least the low-band signal and the high-band signal, to generate the first extended signal by mixing a noise signal and a second extended signal, and to determine the at least one adjustment parameter based on the first extended signal and based on the high-band signal.

57. The computer-readable storage device of claim 56, wherein the operations further comprise:

generating the second extended signal by filtering a third extended signal, wherein a bandwidth of the second extended signal corresponds to the high-band frequency range; and

generating the third extended signal by applying the non-linear processing function to the low-band signal.

58. A computer-readable storage device storing instructions that, when executed by a processor, cause the processor to perform operations comprising:

receiving low-band data corresponding to at least a low-band signal of an input audio signal;

decoding the low-band data to generate a synthesized low-band audio signal;

determining a characteristic of the low-band signal;

selecting a non-linear processing function of a plurality of non-linear processing functions based on the characteristic; and

generating a synthesized high-band audio signal based on the synthesized low-band audio signal and the non-linear processing function.

59. The computer-readable storage device of claim 58, wherein the operations further comprise determining a parameter associated with a frame of the input audio signal, and wherein the non-linear processing function is selected based on the parameter.